Three-Dimensional Printing of Bisphenol A-Free Polycarbonates.

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Public Summary:
We reported, for the first time, a novel method to develop a new class of photopolymerizable BPA-free polycarbonates that can be used in optical 3D printing to fabricate structures on both the microscale and the nanoscale. A green and robust pathway to prepare these new polycarbonates was also presented as a two- step reaction involving mild thermal ROP and low-intensity visible light-induced polymerization. The mechanical properties of these biomaterials can be tuned by adjusting the ratio of the two carbonate compositions, which offers great flexibility to tailor materials for specific applications. Given the biocompatibility, controllable mechanical properties, and printability on the advanced optical 3D printing systems, our biomaterials would have significant impact in numerous applications including biomedical devices, tissue/ organ-on-chip, biosensors, biorobotics, and healthcare products.

Scientific Abstract:
Polycarbonates are widely used in food packages, drink bottles, and various healthcare products such as dental sealants and tooth coatings. However, bisphenol A (BPA) and phosgene used in the production of commercial polycarbonates pose major concerns to public health safety. Here, we report a green pathway to prepare BPA-free polycarbonates (BFPs) by thermal ring-opening polymerization and photopolymerization. Polycarbonates prepared from two cyclic carbonates in different mole ratios demonstrated tunable mechanical stiffness, excellent thermal stability, and high optical transparency. Three-dimensional (3D) printing of the new BFPs was demonstrated using a two-photon laser direct writing system and a rapid 3D optical projection printer to produce structures possessing complex high-resolution geometries. Seeded C3H10T1/2 cells also showed over 95% viability with potential applications in biological studies. By combining biocompatible BFPs with 3D printing, novel safe and high-performance biomedical devices and healthcare products could be developed with broad long-term benefits to society.